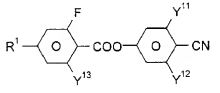
Patent Claims

1. An electro-optical liquid-crystal display comprising a realignment layer, for realigning liquid crystals, and a liquid-crystalline medium of positive dielectric anisotrophy,

wherein said medium comprises one or more compounds of formula I



I

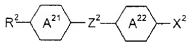
wherein

R^1 is H, alkyl having 1 to 7 carbon atoms, alkoxy having 1 to 7 carbon atoms, alkenyl having 2 to 7 carbon atoms, alkenyloxy having 2 to 7 carbon atoms or alkoxyalkyl having 2 to 7 carbon atoms, and

Y^{11}, Y^{12} and Y^{13} are each, independently of one another, H or F; and

wherein when an electric voltage is applied to said display an electric field is generated which has a component parallel to the liquid-crystal layer for realignment of the liquid crystals.

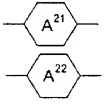
2. A liquid-crystal display according to Claim 1, wherein said medium comprises one or more compounds of formula II:



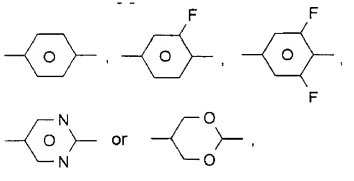
II

wherein

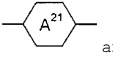
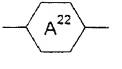
R^2 is alkyl having 1 to 7 carbon atoms, alkoxy having 1 to 7 carbon atoms, alkenyl having 2 to 7 carbon atoms, alkenyloxy having 2 to 7 carbon atoms or alkoxyalkyl having 2 to 7 carbon atoms,

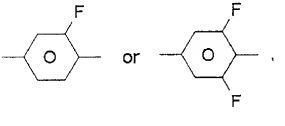


are each, independently of one another,



and

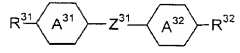
at least one of  and  is



X^2 is F, Cl or CN; and

Z^2 is $-CH_2CH_2-$, $-COO-$, $-CF_2O-$ or a single bond.

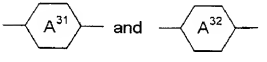
3. A liquid-crystal display according Claim 1, wherein said medium comprises at least one compound of formula III



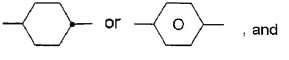
III

wherein

R^{31} and R^{32} are each, independently of one another, alkyl having 1 to 7 carbon atoms, alkoxy having 1 to 7 carbon atoms, alkenyl having 2 to 7 carbon atoms, alkenyloxy having 2 to 7 carbon atoms or alkoxyalkyl having 2 to 7 carbon atoms,

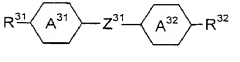


are each, independently of one another,



Z^{31} is $-CH=CH-$, $-COO-$, $-CH_2CH_2-$ or a single bond.

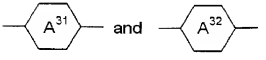
4. A liquid-crystal display according Claim 2, wherein said medium comprises at least one compound of formula III



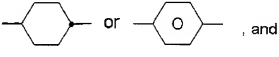
III

wherein

R^{31} and R^{32} are each, independently of one another, alkyl having 1 to 7 carbon atoms, alkoxy having 1 to 7 carbon atoms, alkenyl having 2 to 7 carbon atoms, alkenyloxy having 2 to 7 carbon atoms or alkoxyalkyl having 2 to 7 carbon atoms,

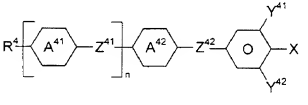


are each, independently of one another,



Z^{31} is $-CH=CH-$, $-COO-$, $-CH_2CH_2-$ or a single bond.

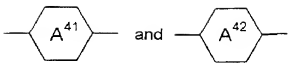
5. A liquid-crystal display according Claim 1, wherein said medium comprises at least one compound of formula IV



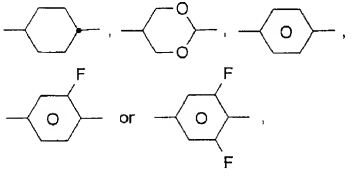
IV

wherein

R^4 is alkyl having 1 to 7 carbon atoms, alkoxy having 1 to 7 carbon atoms, alkenyl having 2 to 7 carbon atoms, alkenyloxy having 2 to 7 carbon atoms or alkoxyalkyl having 2 to 7 carbon atoms,



are each,
independently of one another,



,

Z^{41} and Z^{42} are each, independently of one another, $-CF_2O-$, $-COO-$, $-CH_2CH_2-$ or a single bond,

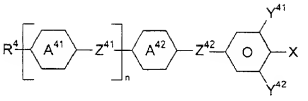
n is 0 or 1,

X is OCF_3, OCF_2H or F,

and

Y^{41} and Y^{42} are each, independently of one another, H or F.

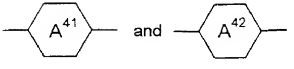
6. A liquid-crystal display according Claim 2, wherein said medium comprises at least one compound of formula IV



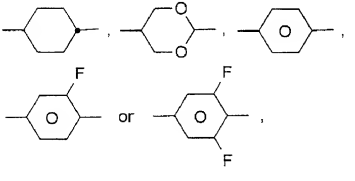
IV

wherein

R^4 is alkyl having 1 to 7 carbon atoms, alkoxy having 1 to 7 carbon atoms, alkenyl having 2 to 7 carbon atoms, alkenyloxy having 2 to 7 carbon atoms or alkoxyalkyl having 2 to 7 carbon atoms,



are each, independently of one another,



,

Z^{41} and Z^{42} are each, independently of one another, $-CF_2O-$, $-COO-$, $-CH_2CH_2-$ or a single bond,

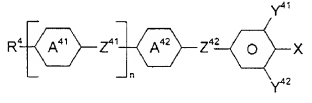
n is 0 or 1,

X is OCF_3, OCF_2H or F,

and

Y^{41} and Y^{42} are each, independently of one another, H or F.

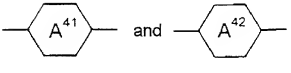
7. A liquid-crystal display according Claim 3, wherein said medium comprises at least one compound of formula IV



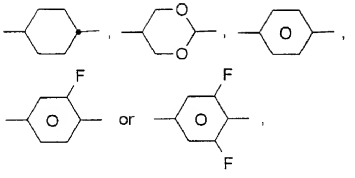
IV

wherein

R^4 is alkyl having 1 to 7 carbon atoms, alkoxy having 1 to 7 carbon atoms, alkenyl having 2 to 7 carbon atoms, alkenyloxy having 2 to 7 carbon atoms or alkoxyalkyl having 2 to 7 carbon atoms,



are each,
independently of one another,



,

Z^{41} and Z^{42} are each, independently of one another, $-CF_2O-$, $-COO-$, $-CH_2CH_2-$ or a single bond,

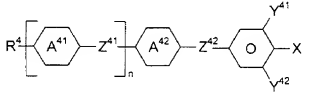
n is 0 or 1,

X is OCF_3, OCF_2H or F,

and

Y^{41} and Y^{42} are each, independently of one another, H or F.

8. A liquid-crystal display according Claim 4, wherein said medium comprises at least one compound of formula IV

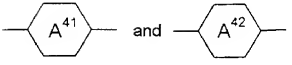


IV

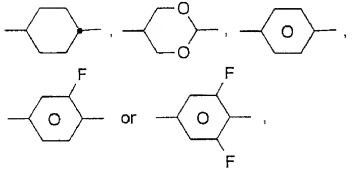
wherein

R^4 is alkyl having 1 to 7 carbon atoms, alkoxy having 1 to 7 carbon atoms, alkenyl having 2 to 7 carbon atoms, alkenyloxy having 2 to 7 carbon atoms

or alkoxyalkyl having 2 to 7 carbon atoms,



are each,
independently of one another,



,

Z^{41} and Z^{42} are each, independently of one another, $-CF_2O-$, $-COO-$, $-CH_2CH_2-$ or a single bond,

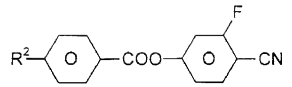
n is 0 or 1,

X is OCF_3, OCF_2H or F,

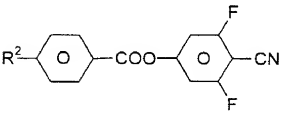
and

Y^{41} and Y^{42} are each, independently of one another, H or F.

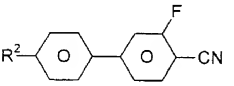
9. A liquid-crystal display according to Claim 2, wherein medium comprises one or more compounds of formulae IIa to IIg



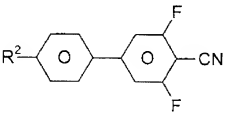
IIa



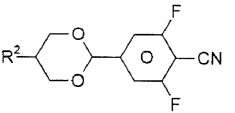
IIb



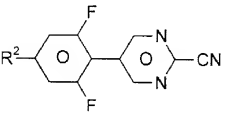
IIc



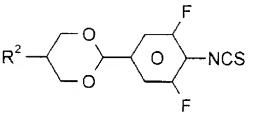
IId



IIe

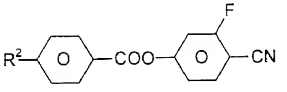


IIf

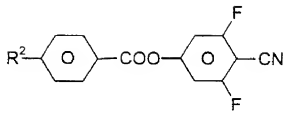


IIg

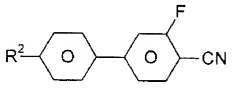
10. A liquid-crystal display according to Claim 4, wherein medium comprises one or more compounds of formulae IIa to IIg



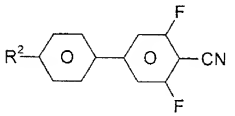
IIa



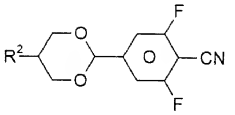
IIb



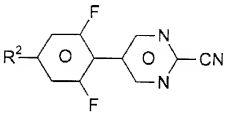
IIc



IId



IIe



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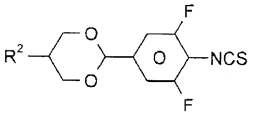
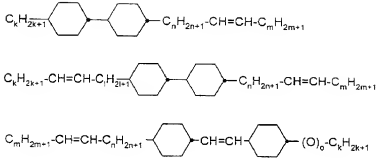


IIg

11. A liquid-crystal display according Claim 3, wherein said medium comprises one or more compounds of formulae IIIa to IIIc



IIIa

IIIb

IIIc

wherein

k is 1, 2, 3, 4 or 5,

m and n are each 0, 1, 2 or 3,

m + n is ≤5, and

o is 0 or 1.

12. A liquid-crystal display according to Claim 8, wherein said medium comprises

- 1 to 35% of one or more compounds of the formula I,
- 3 to 30% of one or more compounds of the formula II,
- 3 to 45% of one or more compounds of the formula III,

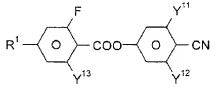
and

- 5 to 60% by weight of at least one compound of the formula IV.

13. A liquid-crystal display according to Claim 1, wherein pixels of the display are addressed by means of an active matrix.

14. A liquid-crystalline medium of positive dielectric anisotropy comprising at least two liquid-crystal compounds

wherein at least one of said compounds is of formula I



I

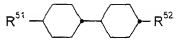
wherein

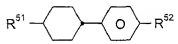
R^1 is H, alkyl having 1 to 7 carbon atoms, alkoxy having 1 to 7 carbon atoms, alkenyl having 2 to 7 carbon atoms, alkenyloxy having 2 to 7 carbon atoms or alkoxyalkyl having 2 to 7 carbon atoms, and

Y^{11}, Y^{12} and Y^{13} are each, independently of one another, H or F.

15. In a method of generating an electro-optical effect using a liquid-crystal display, the improvement wherein a display according to claim 1 is used to generate said effect.

16. A liquid-crystal display according to claim 1, wherein said medium additionally comprises one or more compounds of formulae Va and Vb

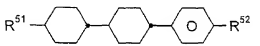

Va

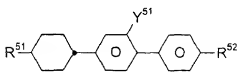

Vb

in which R^{51} and R^{52} are each, independently of one another, alkyl or alkoxy having 1 to 7 carbon atoms or alkenyl, alkenyloxy or alkoxyalkyl having 2 to 7 carbon atoms,

and/or

one or more compounds of formulae Vc and Vd


Vc


Vd

in which

R^{51} and R^{52} independently of one another, are as defined above, and

Y^{51} is H or F.

17. A liquid-crystal display according to Claim 8, wherein said medium comprises

- 2 to 30% of one or more compounds of the formula I,

- 5 to 25% of one or more compounds of the formula II,

- 5 to 40% of one or more compounds of the formula III,

and

- 5 to 50% by weight of at least one compound of the formula IV.

18. A liquid crystal display according to claim 1, wherein said medium has a birefringence of <0.12, a flow viscosity at 20° of <30 $mm^2 \cdot s^{-1}$, a resistivity at 20°C of 5 x 10^{10} to 5 x 10^{13} $\Omega \cdot cm$, a rotational viscosity at 20°C of <130 mPa • s, and a clearing point above 60°C.

19. A liquid-crystal display according to claim 1, wherein said medium has a birefringence of 0.05-0.11.

20. A liquid-crystal display according to claim 1, wherein said medium has a flow viscosity at 20°C of 15-25 $mm^2 \cdot s^{-1}$.

21. A liquid-crystal display according to claim 1, wherein said medium has a resistivity at 20°C of 5 x 10^{11} to 5 x 10^{12} $\Omega \cdot cm$.

22. A liquid-crystal display according to claim 1, wherein said medium has a rotational viscosity at 20°C of 70-110 mPa • s.

23. A liquid-crystal display according to claim 1, wherein said medium exhibits a storage stability of at least 1000 hours at -30°C.